Dynamic Door Displays

David H. Nguyen, Joe Tullio, Tom Drewes, Elizabeth D. Mynatt
College of Computing, GVU Center
Georgia Institute of Technology
Atlanta, GA 30332
[dnguyen, jtullio, drewes, mynatt]@cc.gatech.edu

ABSTRACT
Traditionally, office doors have been used as display surfaces for communicating a variety of information between door owners and visitors. While flexible, doors also burden their owners with the task of maintenance and do not support notions of public and private information. In this paper we introduce the Dynamic Door Display, a tool for enhancing an office door's display capabilities to include automatic updates and tailored displays of private information for particular visitors. This work is based on an initial qualitative study of personalized location-specific information.

Keywords
Ubiquitous computing, context-aware computing, privacy.

DOORS AS AN INFORMATION MEDIUM
This project arose from an initial curiosity into the function of information that is tied to the context of a specific location [3]. In addition, we wished to build upon the work of Mankoff and Schilit [1] by looking at information that has a strong degree of ownership, making it more personalized and sometimes private. Consider office doors. In many office settings, it is common practice to post information on doors in the form of documents and pictures. This information may serve to answer some frequently asked questions when the owner is away, or it may simply provide an expression of the owner's interests or personality. Postings may contain anything from a favorite comic strip to a weekly calendar. These may be intended for permanent display, or may be posted for only a few minutes.

We performed a short qualitative study to examine the motivations and practices behind the use of doors as an information medium. Fifteen private office doors were photographed weekly, with their owners' consent, over a period of six weeks. Afterwards, we asked five owners of these doors to comment on our observations. A number of findings were generated by this study. First, various layouts and types of postings indicate a motivation to use the door as a medium for self-expression. In one case, however, an administrator refrains from posting personal information to her door to maintain a professional décor for business-related visits. Often-sought information such as schedules, conference dates, and upcoming seminars is frequently displayed, but interviews revealed that users are sometimes forgetful in keeping this information current.

Shorter-term messages are frequently used to indicate future availability ("back in 5 minutes") or current location ("at lunch"). In addition, a clear distinction is made between public and private information, with the former regarded as more suitable for display on doors. Lastly, interviewees indicated that their personal web pages provide a larger collection of information on their work and interests. However, much of that information is considered too lengthy to be read during the quick glances that are usually cast at doors.

Although the practice of posting on doors is effective, problems arise. Since it is typically the owner's responsibility to maintain the door's information, postings can quickly go out of date when the owner is too busy or forgetful. In addition, the public nature of the door's surface causes owners to withhold private information that may be useful to a select individual or group.

DESIGN OF DYNAMIC DOOR DISPLAYS
Given the results of our study, we posit that the current practice of posting information on doors can benefit from a computational component – namely, Dynamic Door Displays. The intent is not to replace the existing system, but to let people continue to express themselves through their door postings without worrying about breaching privacy or maintaining the information. Therefore, the new displays automatically update dynamic information. In addition to the owner's current location [4], his/her calendar information is updated. The displays also provide access to private information by allowing visitors to identify themselves through a technology such as electronic tags or speaker identification. They only occupy a small portion of the door, allowing users to continue using paper-based postings as well. Finally, information is displayed in differing levels of detail depending on the owner's privacy requirements with respect to the visiting group or individual. Recall the case of the administrator who could not post personal items. Visitor identification allows friends and colleagues to see personal information about her while business-related visitors are presented with a more formal display. As with the paper-based postings

currently used on office doors, available information is constrained to have some relevance to the door's owner, and it is kept short enough to be comprehended at a brief glance.

PROTOTYPES

Using these design guidelines, we have built several prototypes of the Dynamic Door Display for doors in our work environment. For example, the display on our lab door initially shows a welcome message and a list of current lab residents with available information. Selecting a student allows access to his/her calendar and last known location. Visitors may also leave a voice message or select from a list of short text messages. Our first prototypes used a 40x4 character LCD and four pushbuttons connected to a PC via serial interface (Figure 1a). Since the LCD lacks the graphical richness needed to properly display the variety of information that can be posted on doors, we now use a color display from a Hewlett-Packard 620LX handheld computer (Figure 1b). The touch-sensitivity of the color display eliminates the need for the original pushbuttons. The electronics are housed in a decorative natural cherry casing, but could easily be enclosed in another material to suit the owner. The Dallas Semiconductor iButton system is used to identify and locate colleagues. A Proxim wireless LAN connects the display to the lab network.

Figure 1(a): Original prototype with LCD screen.

Figure 1(b): Current prototype with touch-sensitive screen.

To permit automatic updates to calendar and location information, we use the Context Toolkit [2], a suite of reusable widgets capable of continually monitoring incoming data sensed from the outside world. A widget for each user's calendar and location is periodically queried by the door display to keep the information current.

The interface to our lab door consists of a welcome screen with a group picture of current lab members (Figure 2). Note that a different screen could be used for other groups or individuals. Tapping on any member will access the last known location of that person and offer the option of seeing his/her calendar or leaving a message. If visitors choose to identify themselves using an iButton, the display of calendar information is modified to accommodate the owner's privacy preferences.

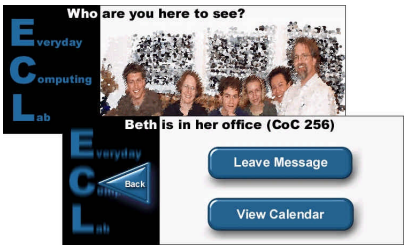

Figure 2: Screens from the lab door display.

FUTURE WORK

Initial response to the door displays has been positive, and we are currently in the process of building several more prototypes to accommodate a demand for them. We are excited to see how new users express themselves through their own custom welcome screens. A web-access version of the interface may offer convenience to remote visitors, but with the understanding that different privacy considerations apply for web access than for "face-to-door" access.

We are also considering the possibility of using audio cues to convey messages from the door owner to identified visitors. Using audio in conjunction with implicit identification would enable a lightweight dialog between door and visitor; akin to the passing glance we typically give a colleague's door. To this end, we are investigating the use of RF tags and speaker identification.

Since the door displays are tied to a particular location, it is possible to develop applications that take advantage of this property. For instance, a simple "you are here" display could assist in orienting visitors from any door in our building.

Finally, we are interested in inferring the door owner's availability by using implicit sensing and probabilistic inference. In this way, visitors could be notified of availability without disturbing the office occupants.

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REFERENCES

1. Mankoff, J. and Schilit, B. Supporting Knowledge Workers Beyond the Desktop with PalPlates, in Proceedings of CHI'97 (Atlanta GA, March 1997), ACM Press, 550-551.
2. Salber, D., Dey, A., and Abowd, G. The Context Toolkit: Aiding the Development of Context-Enabled Applications, in *Proceedings of CHI'99* (Pittsburgh PA, May 1999), ACM Press, 434-441.
3. Spohrer, J.C. Information in Places. *IBM Systems Journal 38*, 4 (1999).
4. Weatherall, N. and Hopper, A. Predator: A Distributed Location Service and Example Applications, in *Proceedings of CoBuild'99* (Pittsburgh PA, October 1999), Springer, 127-139.